



EV Load Shape Presentation

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Order of Presentation

- Overview of ADM's EV Infrastructure Load Model
 - How the model functions
 - Key model drivers
- Model Updates
- Comparison of LDV Load Shapes



EV Infrastructure Load Model Overview





What is The EV Infrastructure Load Model?

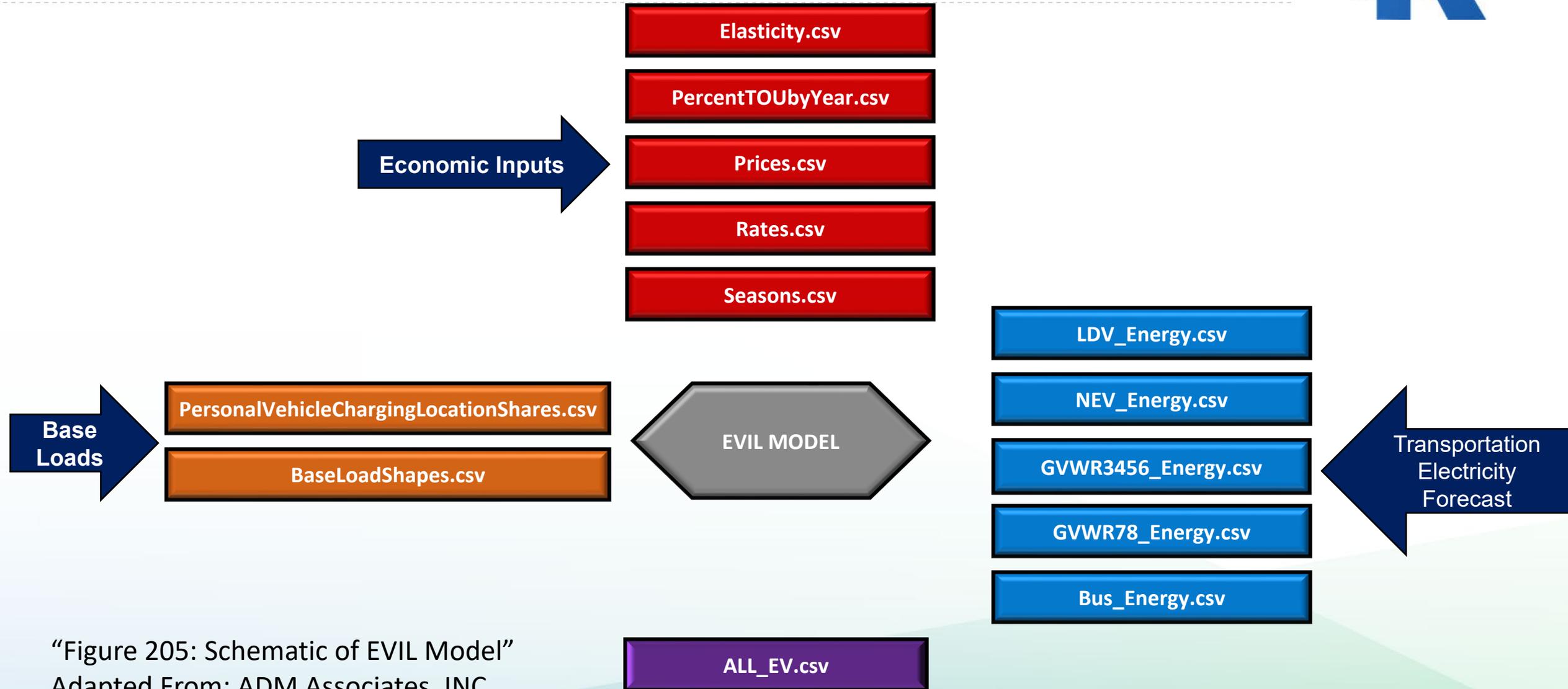
- The Electric Vehicle Infrastructure Load Model was constructed by ADM Associates to provide CEC with transportation hourly electricity load shapes for commercial and residential sectors.

The model:

- Composed of several R executable scripts.
- Uses several external static and auxiliary model outputs as model inputs.
- Works as a platform for future scenario building for utility electricity rate structures and transportation energy forecasts.



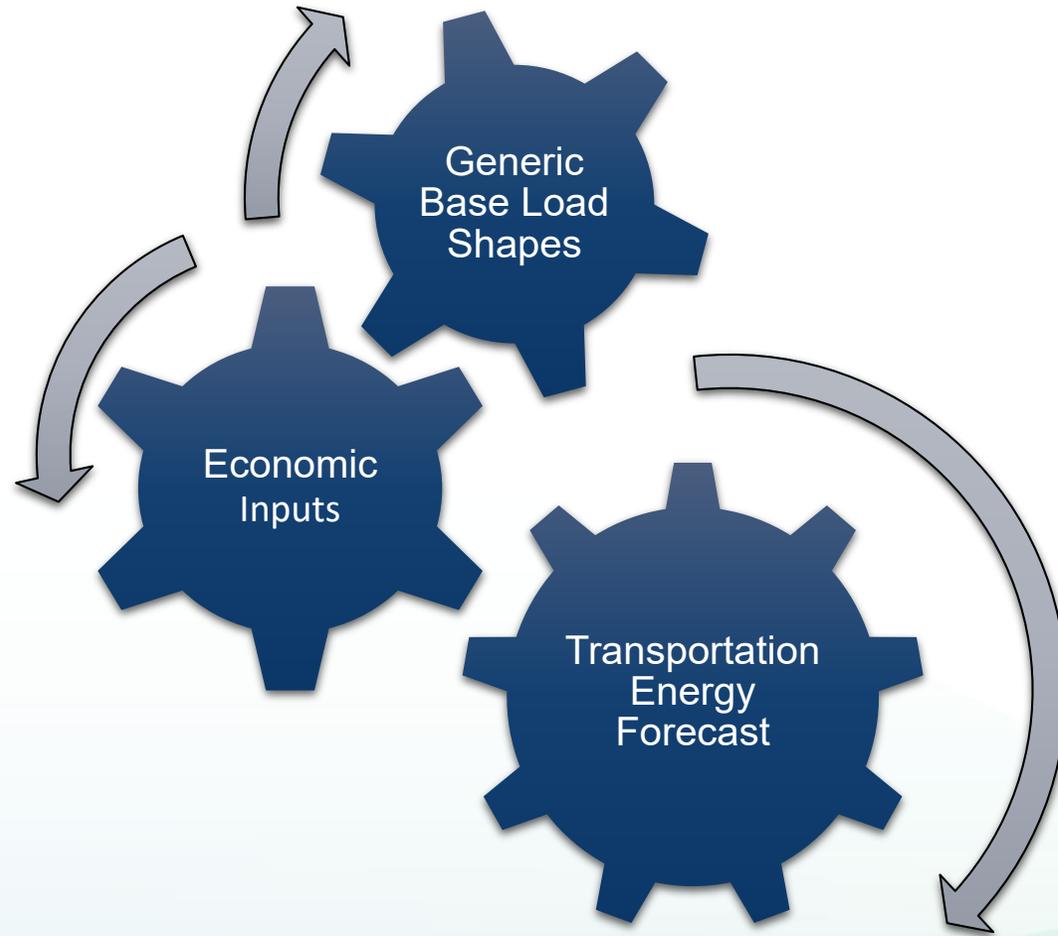
Model Schematic



“Figure 205: Schematic of EVIL Model”
Adapted From: ADM Associates, INC.



Key Model Drivers





Driver 1: Transportation Electricity Demand Forecast

- On-road Statewide annual electricity demand by vehicle category is disaggregated to climate zones.
- Each climate zone maps to a utility planning area.
- Vehicle categories are described in more detail in following slides.
 - Includes light-, medium-, and heavy-duty vehicles.



Source: CEC Staff



Driver 2 : Economic Inputs

- Economic Inputs adjust the charging profiles for each forecast zone.
- Adjustment factors are determined as follows:

$$A_h = \max(0, 1 + TOU\% \times e \times (PR_h - 1))$$

Where:

- A_h is the adjustment factor for hour h
- TOU% is the percentage of customers that have a TOU rate
- PR_h is the price ratio for hour h, defined as the price prevailing at hour h divided by the lowest available price for the given day, at the same location
- e is the Elasticity Factor

Source: ADM Associates, INC.



Driver 2: Economic Inputs

- Commercial and residential TOU rates serve as input to the model.
 - Residential TOU rates only apply to light-duty vehicles charging at home.
- Elasticity factors are an adjustable input to the model.
 - ADM determined default values by comparing ChargePoint data to the Joint IOU report from 2017
 - Values are calibrated by CEC staff to account for updated economic parameters
- TOU% requires a forecasted value by utility
 - Can model different participation possibilities
 - Currently includes a low, mid, and high forecast
- Adjustment factors decrease an hour's base load percentage
 - In some cases where price ratios are very large, adjustors may drive the base load percent of daily charge to zero



Driver 3: Base Load Shapes

- Base load shapes are generic charging profiles that distribute % of load across an 8760-hour year.
 - Model assumes 261 weekdays and 104 weekend days in a year.
- The % of load assigned to each hour of the year is modified by the adjustment factor described in previous slides.

Example:

$$A_h = 1 + \%TOU * e * (PR_h - 1)$$

Where: %TOU participation = 0.60 , Price elasticity = -0.3 , and $PR_h = 2$.

$$A_h = 0.82$$

$$L_{ah} = L_{uh} * A_h$$

Where: L_{ah} = Adjusted load for hour h , L_{uh} = Unadjusted load for hour h.

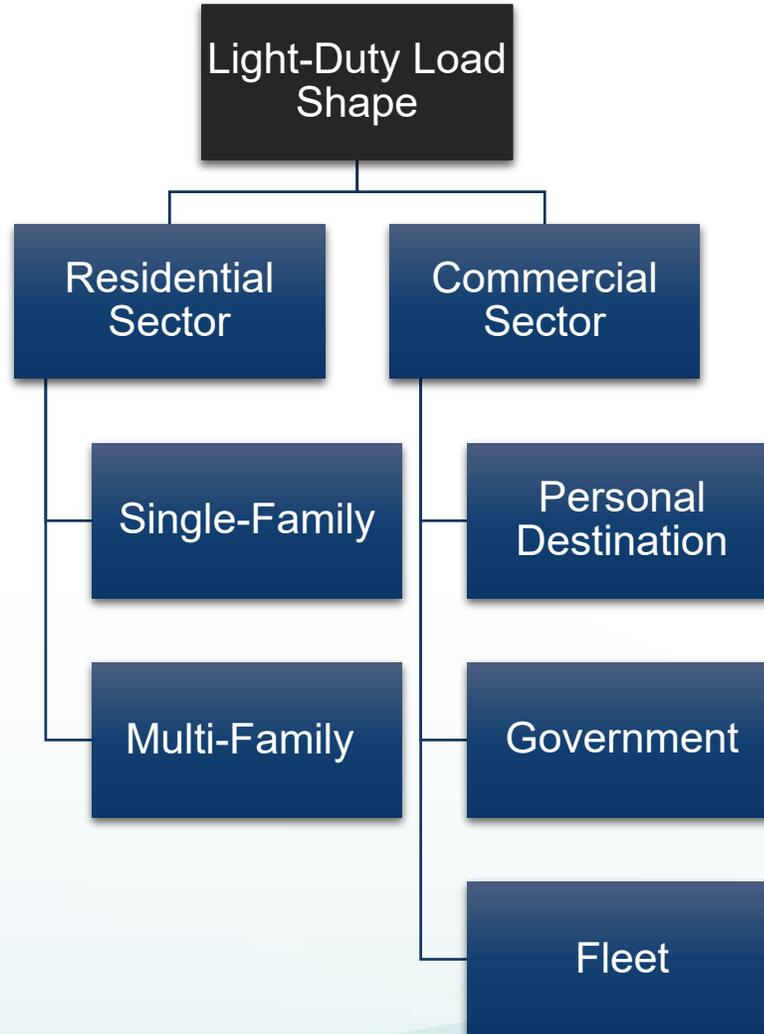
Assuming $L_{uh} = 0.10$ (10% of the total daily charging load occurs during hour h.)

$$L_{ah} = 0.082$$

In other words , electricity load for hour h is 82% of what it would have been in absence of an adjustment factor.

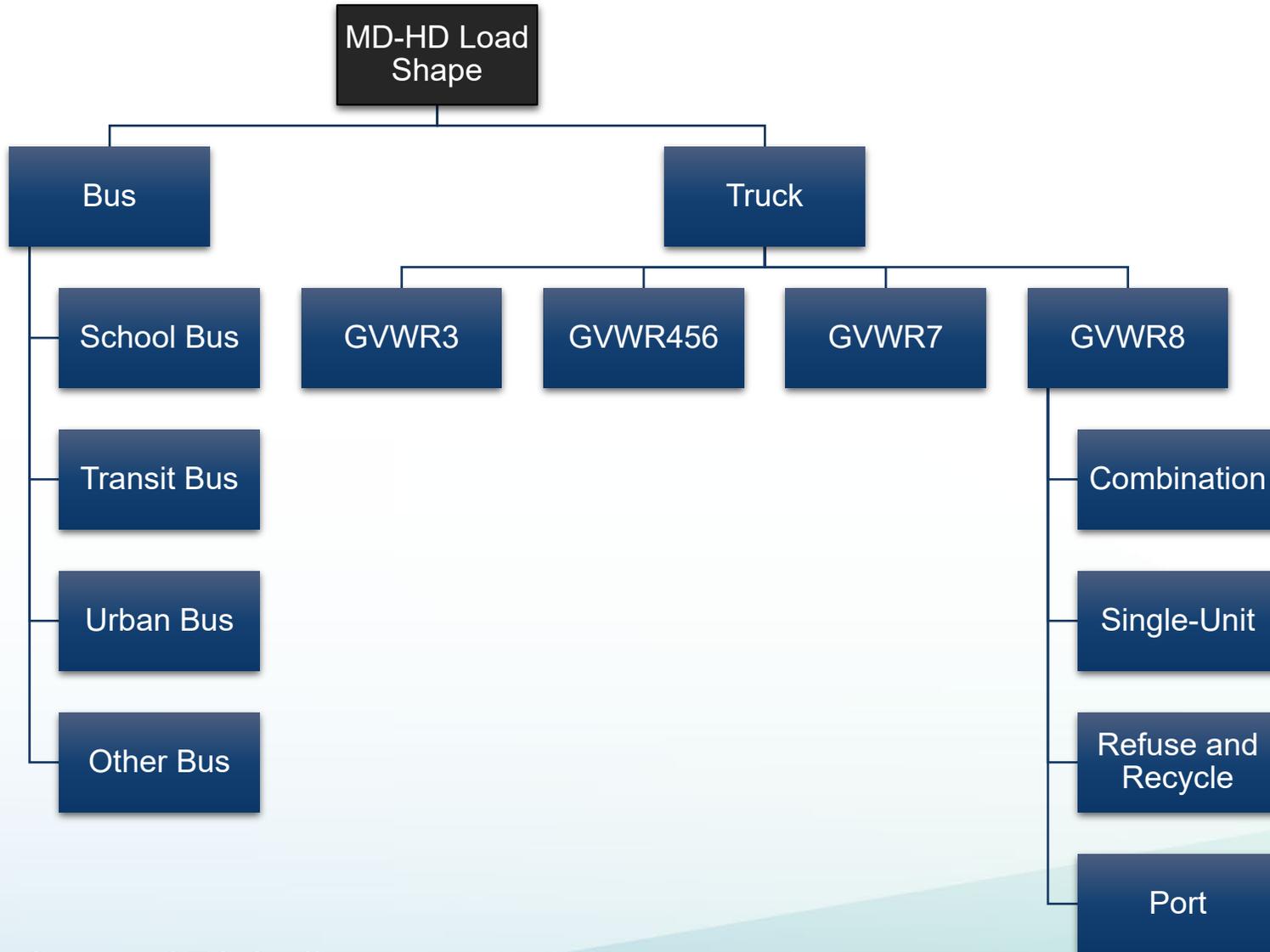


Light-Duty Load Shape





Medium- and Heavy-Duty Load Shape



Class 3 - 10,001 to 14,000 lbs				
Class 4 - 14,001 to 16,000 lbs				
Class 5 - 16,001 to 19,500 lbs				
Class 6 - 19,501 to 26,000 lbs				
Class 7 - 26,001 to 33,000 lbs				
Class 8 - 33,001 lbs & Over				



Model Updates





Economic Updates

- Time-of-use rates have been updated in the model to capture the hourly price of electricity by utility.
- Residential Time-of-use rate participation revised to reflect updates to the TOU rate default process.

Table 1: TOU Rates Model Input

Utility	Sector	Rate
PGE	Residential	EV-2A
PGE	Commercial	BEV
SCE	Residential	TOU-D-PRIME
SCE	Commercial	*TOU-EV-7, TOU-EV-8, TOU-EV-9
SDGE	Residential	*EV-TOU-2, EV-TOU-5
SDGE	Commercial	TOU-A2

*Weighted averages performed based on TOU rate participation from the Joint IOU Report.

Source: CEC Staff



Load Shape Updates

- Previously, our model considered **3** medium- and heavy-duty load shapes (1 bus, 2 truck). Our model now considers **11** unique MD-HD load shapes.
 - New MD-HD load shapes developed through collaborative efforts with our Fuels and Transportation Division and LBNL.
- Personal vehicle charging location: single-family, multi-family, and destination centers.
 - Updated with residential access assumptions from the AB2127 report's EAD Aggressive scenario.
 - Personal destination load shape developed from the AB2127 report's EAD Aggressive scenario.

Table 2: Personal Vehicle Charging Location Shares

Sector	2020	2025	2030	2035
Single-Family	71%	64%	58%	50%
Multi-Family	8%	9%	10%	11%
Destination *commercial	21%	27%	32%	39%

Source: CEC Staff

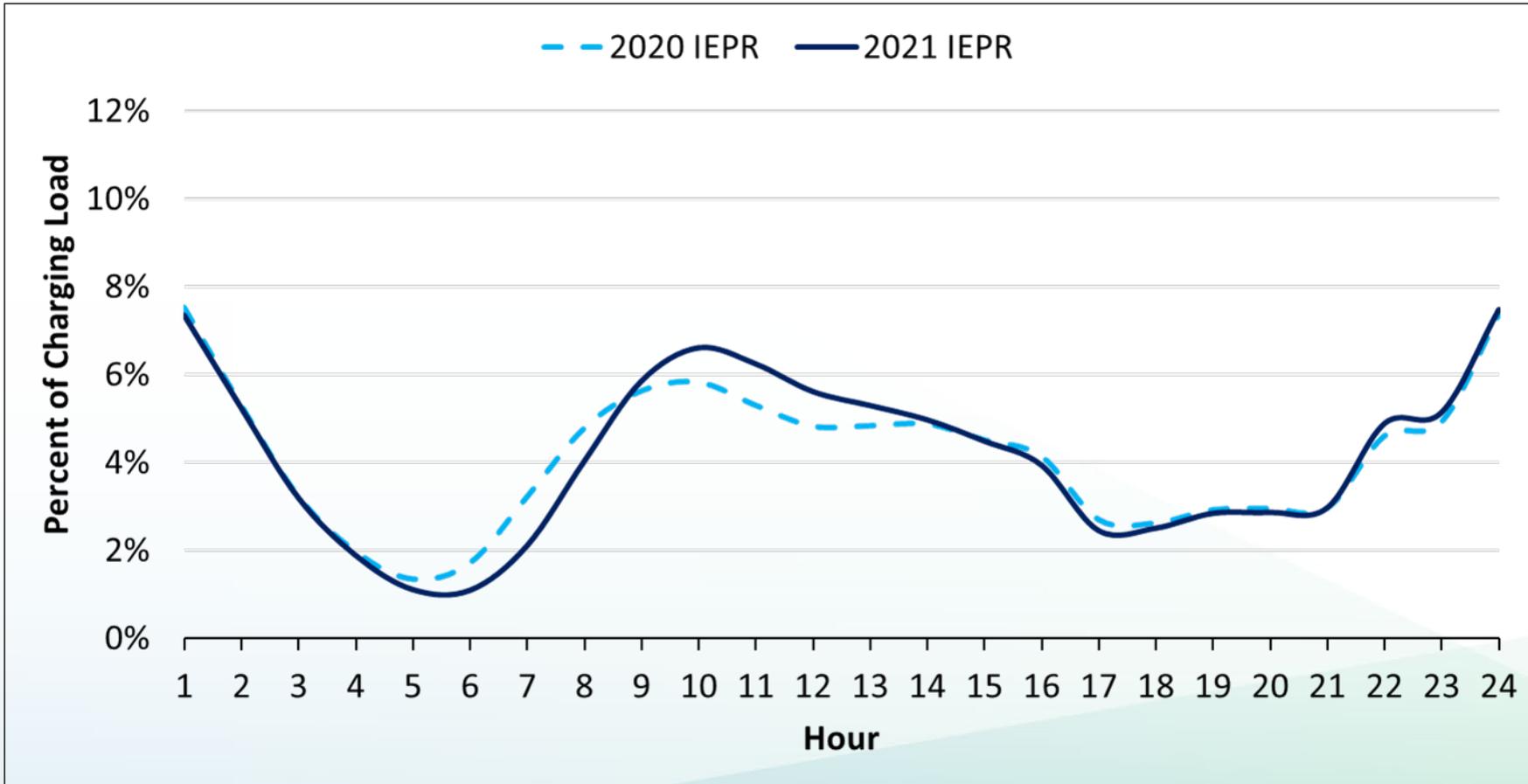


LDV Load Shape Comparisons



CAISO LDV Charging Load Shape

- The following mid-case load shapes for an average summer weekday in 2030.

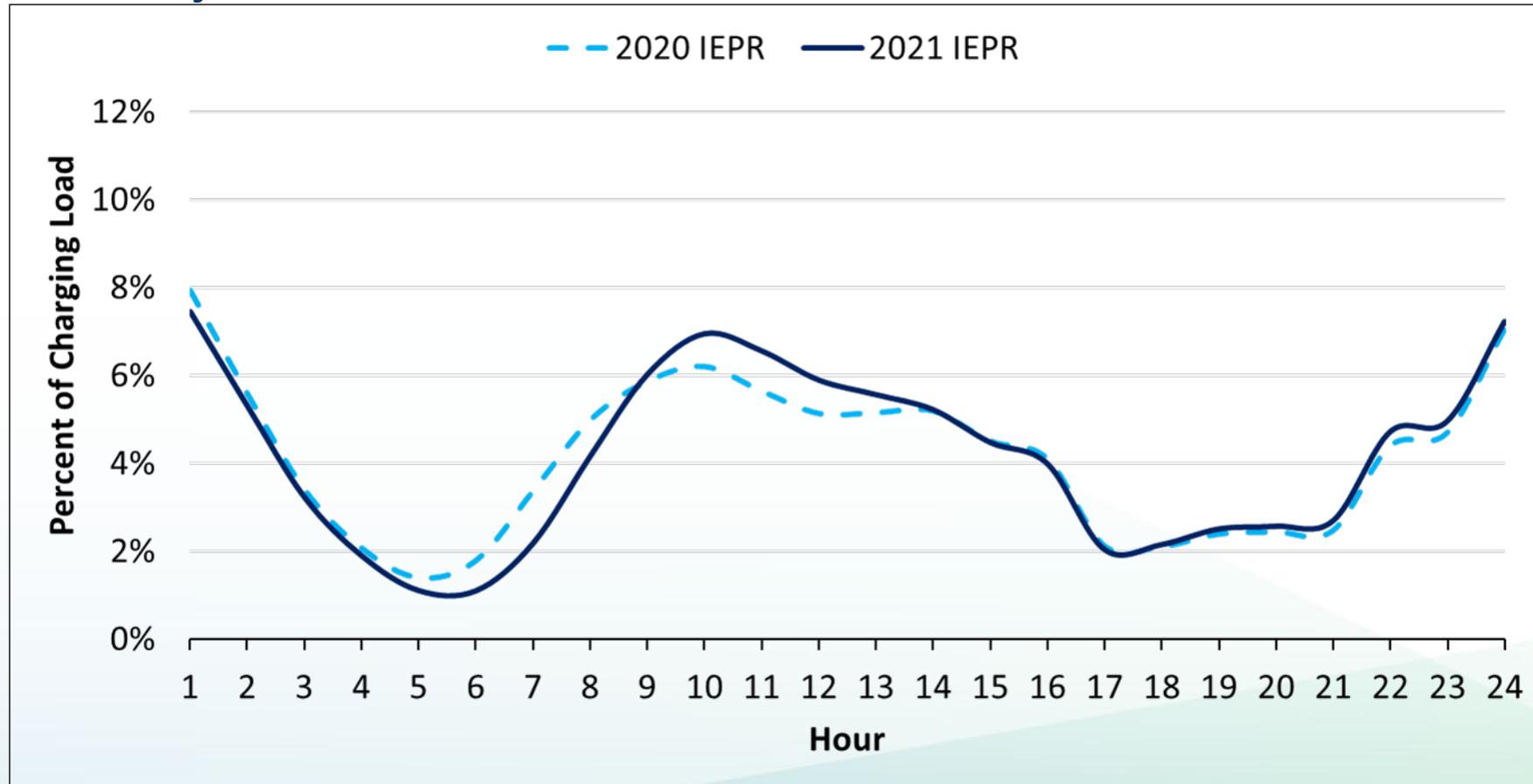


Source: CEC Staff



PGE LDV Charging Load Shape

- The following mid-case load shapes for an average summer weekday in 2030.

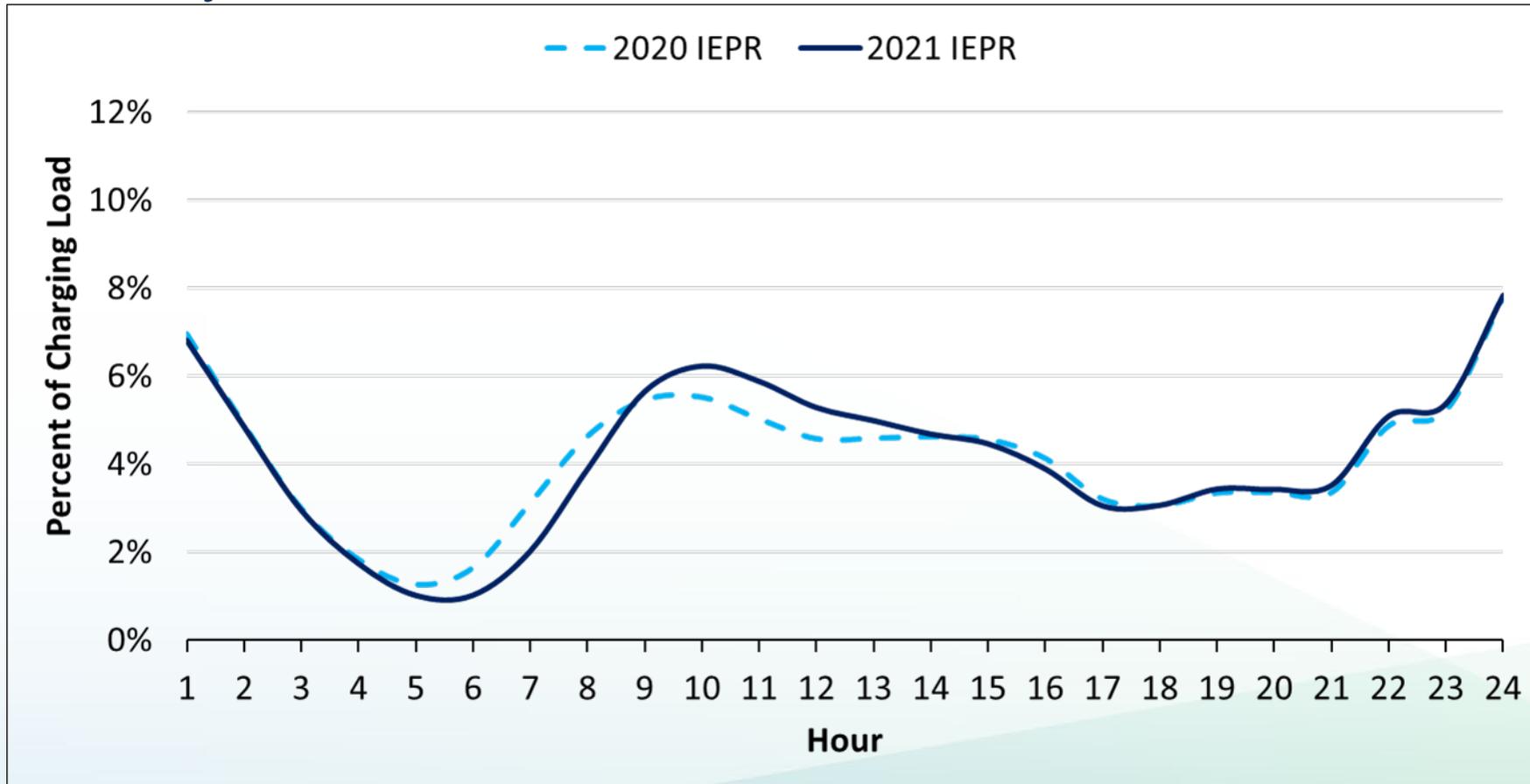


Source: CEC Staff



SCE LDV Charging Load Shape

- The following mid-case load shapes for an average summer weekday in 2030.

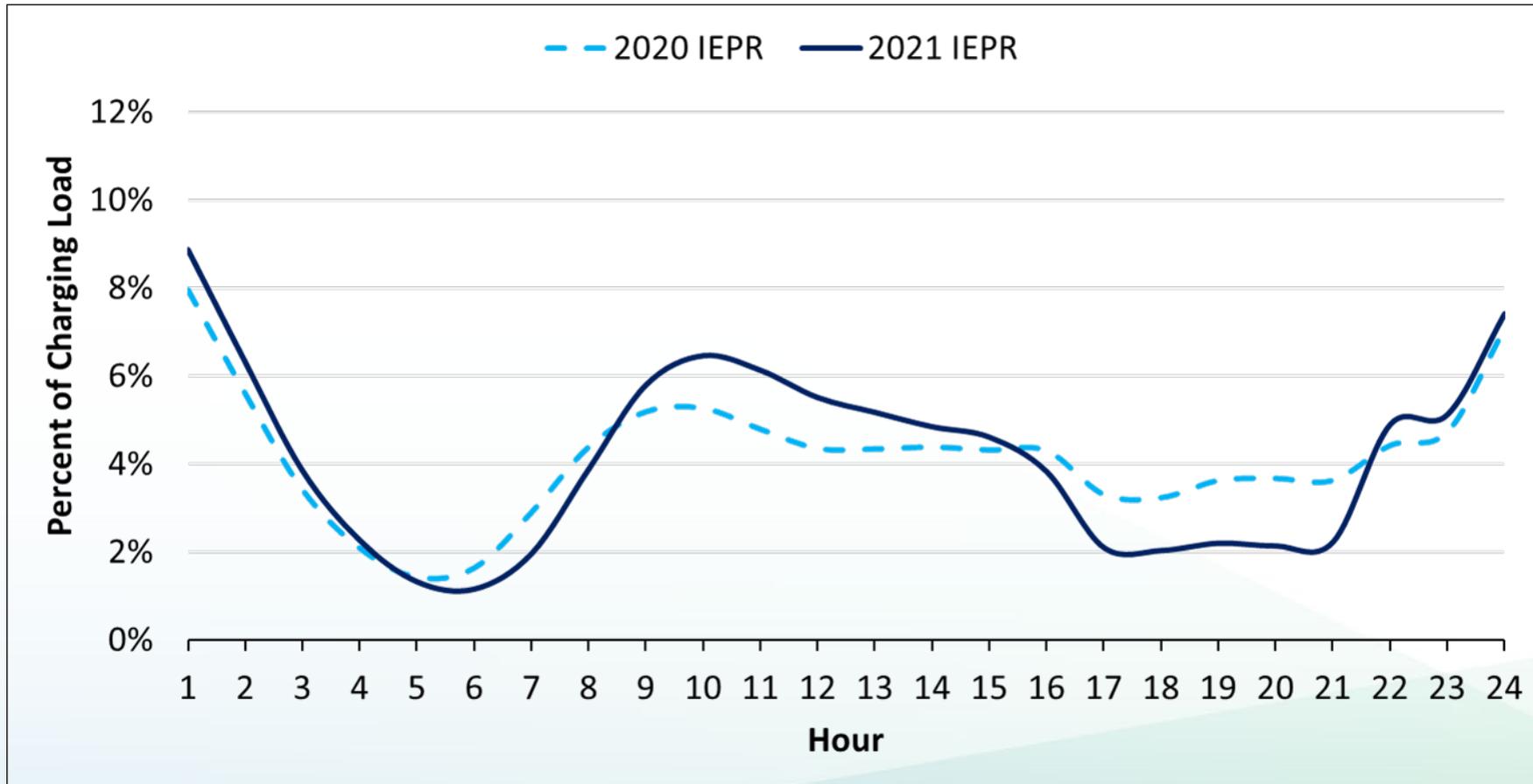


Source: CEC Staff



SDGE LDV Charging Load Shape

- The following mid-case load shapes for an average summer weekday in 2030.



Source: CEC Staff



Closing Remarks

- Link to ADM's complete documentation for the EVIL model, located in Chapter 10:
 - Link: <https://ww2.energy.ca.gov/2019publications/CEC-500-2019-046/CEC-500-2019-046.pdf>
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Thank You!

